Small Business Innovation Research/Small Business Tech Transfer

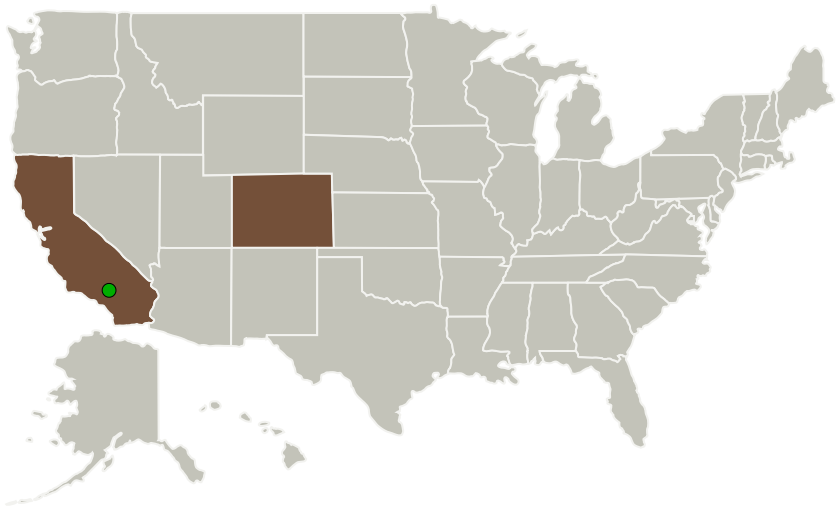
Non-Parametric, Closed-Loop Testing of Autonomy in Unmanned Aircraft Systems, Phase I

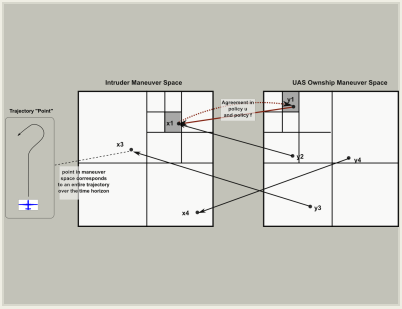
Completed Technology Project (2014 - 2014)

Project Introduction

The proposed Phase I program aims to develop new methods to support safety testing for integration of Unmanned Aircraft Systems into the National Airspace (NAS) with a particular focus on testing the collision avoidance (CA) algorithms of a UAS Sense-and-Avoid (SAA) system. The two primary issues addressed by this research are: (i) the risk that incorrect/mismatched modeling assumptions will skew simulation analyses and (ii) the fundamental difficulty of verifying the performance of autonomous systems that dynamically react to the environment. In particular, this research program would develop novel methods for conducting non-parametric, closed-loop simulation testing of collision avoidance algorithms. The technology generates a campaign of simulation experiments that automatically adapt to the algorithms in question. The purpose of this innovation is to expose potential vulnerabilities in UAS autonomy that are generated through the interaction of autonomous UAS algorithms with other agents such as an intruding aircraft operating under ``right of way rules". This work augments both the probabilistic open-loop testing methods, where agents do not react, and closed-loop testing where agent behavior is fixed a priori.

Primary U.S. Work Locations and Key Partners





Non-Parametric, Closed-Loop Testing of Autonomy in Unmanned Aircraft Systems Project Image

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Organizations Performing Work	Role	Type	Location
Numerica Corporation	Lead Organization	Industry	Fort Collins, Colorado
Armstrong Flight Research Center(AFRC)	Supporting Organization	NASA Center	Edwards, California

Primary U.S. Work Locations	
California	Colorado

Project Transitions

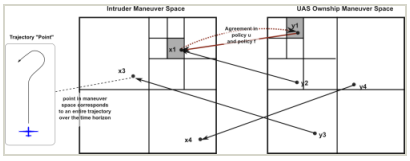
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140500)*

Images



Project Image
Non-Parametric, Closed-Loop Testing of Autonomy in Unmanned Aircraft Systems Project Image *(https://techport.nasa.gov/image/132037)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Numerica Corporation

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Jason Adaska

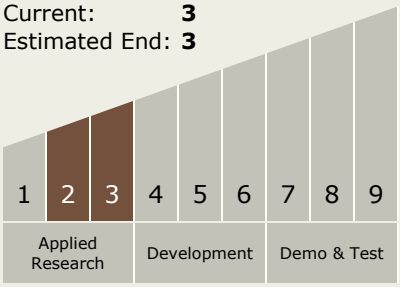
Co-Investigator:
Jason Adaska

Non-Parametric, Closed-Loop Testing of Autonomy in Unmanned Aircraft Systems, Phase I

Completed Technology Project (2014 - 2014)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.2 Modeling
    - TX11.2.2 Integrated Hardware and Software Modeling

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System